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Development of Pigmentation in the Pupa and Callow of Trachymyrmex septentrionalis (Hymenoptera: Formicidae)

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The color of fungus-growing ants (Attini) is notoriously variable, as is often the case among ants in general. Various forms have been described, using color as one of the characters. The most northerly of all fungus-growers, *Trachymyrmex septentrionalis* McCook, is an example.

Wheeler (1907) created *obscurior* var. nov. as "necessary to distinguish the darker southern form" of *septentrionalis*. Later (1911) he created *vertebrata* on the basis of color and used color in large part in naming *seminole*. Creighton (1950) retained *obscurior* and *seminole* as geographical races but synonymized *vertebrata* with the typical form.

It is the purpose of this article to demonstrate the development of pigmentation in several of the stages of this species in its three castes, as a contribution both to embryology and to systematics. During the development of pigmentation, intermediate stages may also be useful in indicating relationships between species. In any case a particular color form that is known only from original or a few collections should always be suspect.

New Jersey colonies of *Trachymyrmex septentrionalis* have been kept in my laboratory for years and results of some obser-

vations and experiments published (Weber 1956). During the summer of 1963 fresh colonies from the same site, the intersection of U. S. Highway 322 with the boundaries of Atlantic and Gloucester Counties, were used for the following studies. One colony (No. 4263) taken 4 June 1963 was the source for the specimens drawn.* It was normal in all respects and had two chambers at depths of 8 cm and 20 cm in sand; temperatures were 24.5 and 19.9° C., respectively. The fungus garden was formed on typical vegetal substrate. Eggs were recognized 6 June. By 20 June in the laboratory there was a brood of large larvae, some 4 mm long. Temperatures were variable, 24–30° C., until on 15 July the colony was placed in a room of 23.4–24.0° C. Pupae appeared on 27 June and the first callows of all castes on 5 July. The callow stage may be defined as the stage following the pupa when the ant has been removed from the exuvia and can stand but lacks full pigmentation. At first it stands unsteadily on its legs, then it starts to walk about and feed on the fungus by itself.

The descriptions and figures below were made from living specimens (except Figs. 9–10) since the color changes after death.

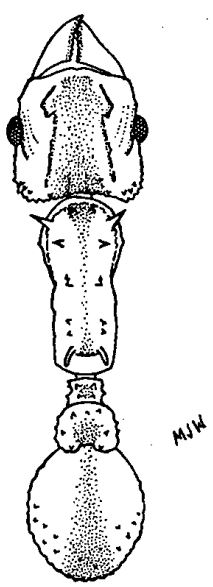
Pigmentation in the Pupa

The compound eyes become pigmented before other parts of the body in all castes. Ocelli of the males and females become pigmented before the body. In all castes the masticatory border of the mandibles next darkens slightly, followed by a brownish outline of some of the thoracic sutures (male and female). By this time the pupa has become a grayish white. As the mandibular margins darken, the frontal ridges of the head and

* By Marilyn Warkentin under the National Science Foundation Undergraduate Research Participation Program.

Figs. 1–7. *Trachymyrmex septentrionalis* callows drawn from life (appendages omitted).

1. Worker, 1st week. 2. Worker, 2nd week. 3. Worker, nearly adult pigmentation. 4. Female, 1st week. 5. Female, 2nd week. 6. Female, nearly adult pigmentation. 7. Male, 1st week.



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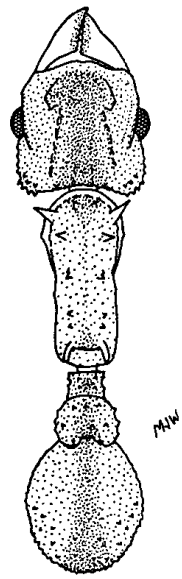

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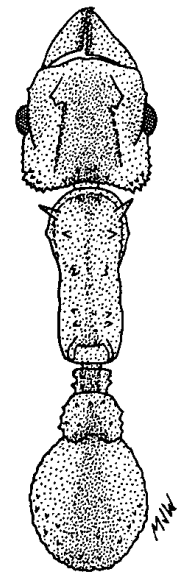

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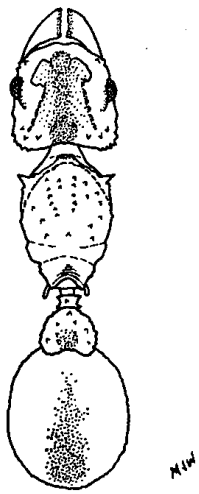

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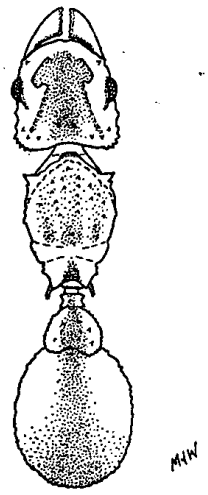

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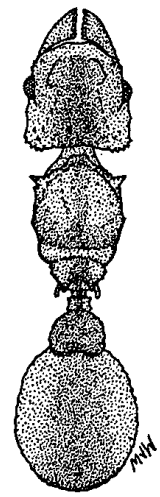

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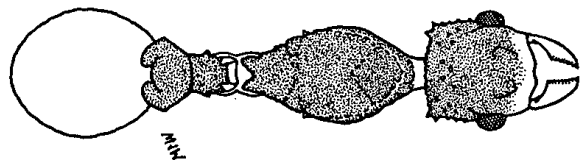

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tubercles of the body become faintly indicated. The wing pads of the sexes darken distally before proximally. The entire integument becomes a pale brown as the pupa reaches maturity, the male gaster remaining paler than the rest of the body (Fig. 8).

Pigmentation in the Callow

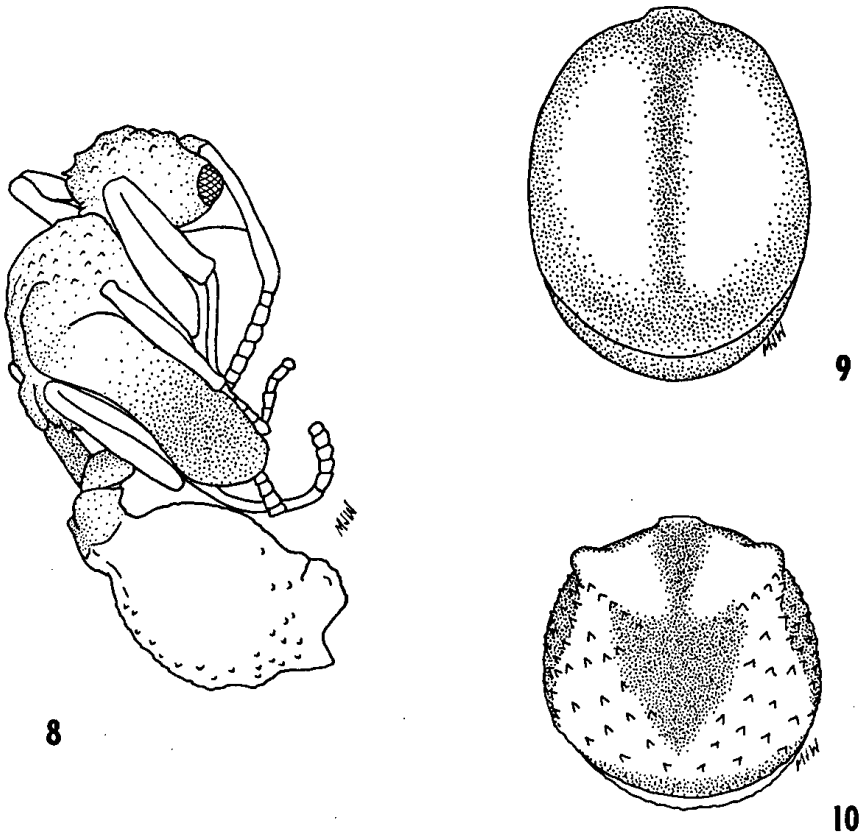
The callow is unable to emerge from the pupal skin without the aid of the worker although it can start the process. The exuvia is removed by the intensive licking of it by one or more workers. During this period the general pale brown darkens slightly.

When the callow has become freed of the exuvia pigmentation proceeds as shown in the figures (Figs. 1–7). The worker develops a faint mid-dorsal streak from the clypeus to the posterior of the first gastric segment. This is widest anteriorly and posteriorly. Lateral areas then darken and render the dorsal streak less conspicuous but it is generally retained throughout life to a variable extent. The female pattern is similar except that a dark area marks the ocellar region and there are three dark streaks on the thorax. The male differs markedly from the female and worker in having a uniformly pale brown gaster.

Pigmentation in the Adult

Older ants in this species tend to be darker than younger ones during the summer in nature. By the fall of the year all are mostly dark ferruginous with faint indications of the callow pattern. Worker callows that emerge in the laboratory tend to be pale ferruginous and remain this color for a much longer time than in nature.

Ants of the genus *Acromyrmex,* closely related and perhaps derived from *Trachymyrmex,* are also a ferruginous color of variable intensity. The female of *Acromyrmex* (*Moellerius*) *versicolor* Pergande has a characteristic gastric pattern (Fig. 9). The gaster of the female of *Acromyrmex* (*A*) *coronatus globoculis* Forel has a bold hastate pattern (Fig. 10).



FIGS. 8–10. Pattern of pigmentation.

8. Male pupa of *Trachymyrmex septentrionalis* showing early pigmentation. 9. Adult female gaster of *Acromyrmex* (*Moellerius*) *versicolor* Pergande, Imperial County, California. 10. Adult gynetype female gaster of *Acromyrmex coronatus globoculis* Forel of British Guiana. The dark brown spear-shaped area is on a yellowish brown background.

DEVELOPMENT OF ISOLATED BROOD

Brood was isolated from adult ants on 1 August 1963 in a container of sterile quartz sand kept moistened with distilled water. Each specimen was isolated in a shallow depression, in a numbered series, and its progress noted. All had a coating of the fungus garden mycelium as is normal in most Attini. The temperature was maintained at 23.4° C. ± 0.5°.

The history of nine males is given in Table 1.

TABLE 1

No.	1 August	4 August	6 August	9 August
1	white pupa, nearly black eyes	brown, dark wing pads		moves
2	white pupa, gray eyes	dark eyes		brown
3	white pupa, dark gray eyes	dark wing pads		moves
4	pale yellow pupa, dark gray eyes	brown, dark wing pads	moving legs	nearly black
5	pale brown pupa, appendages yellow	dark brown	moves	dark
6	white pupa, gray eyes	dark eyes		dark
7	white pupa, unpigmented eyes	gray eyes		pale brown
8	white pupa, pale gray eyes	shrivelling		pale brown
9	semi-pupa	became pupa	gray eyes	pale gray

In addition, No. 3 moved his mouthparts on the 7th and No. 1 moved more generally on this day.

An isolated white worker pupa with unpigmented eyes on 1 August had gray eyes on 4 August and dark gray eyes on 8 August and 10 August. The integument became gray on 9 August.

Of three workers in the semi-pupa stage on 5 August, one became a pupa on 7 August and the other two on 9 August, indicating a duration of this stage of 2–3 days at 24° C.

Of a cluster of some 12–15 new eggs on 5 August the first larva developed on 16 August in the same container that held the above males and workers.

All of the above specimens were later preserved when it became clear that development could not proceed further in the absence of the social environment. In the ant colony they would have been licked repeatedly by the workers and moved from place to place. These fragmentary data, however, afford specific developmental times that may be extrapolated to the normal colony.

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